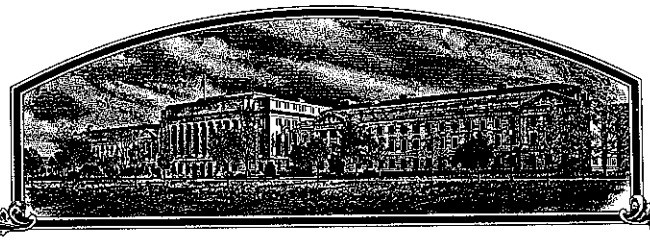

No. 9400059

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Minnesota Agricultural Experiment Station

Whereas, THERE HAS BEEN PRESENTED TO THE

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED NOVEL VARIETY OF SEXUALLY REPRODUCED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF eighteen YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, IMPORTING IT, OR EXPORTING IT, OR USING IT IN PRODUCING A HYBRID OR DIFFERENT VARIETY THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT. UNITED STATES SEED OF THIS VARIETY (1) SHALL BE SOLD BY VARIETY NAME ONLY AS A CERTIFIED SEED AND (2) SHALL CONFORM TO THE NUMBER OF GENERATIONS SPECIFIED BY THE OWNER OF THE RIGHTS. (84 STAT. 1542, AS AMENDED, 7 U.S.C. 2321 ET SEQ.)

BARLEY

'Royal'

In Testimony Whereof, *I have hereunto set my hand and caused the seal of the* Plant Variety Protection Office *to be affixed at the City of* Washington, D.C. *this* 31st *day of* August *in the year of our Lord one thousand nine hundred and* ninety-four.

Attest:

Kenneth W. Evans

Commissioner
Plant Variety Protection Office
Agricultural Marketing Service

Secretary of Agriculture

FORM APPROVED: OMB 0581-0055, Expires 1/31/91

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE

(Instructions on reverse)

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until certificate is issued (7 U.S.C. 2426).

1. NAME OF APPLICANT(S) *(as it is to appear on the Certificate)*
Minnesota Agricultural Experiment Station

2. TEMPORARY DESIGNATION OR EXPERIMENTAL NO.
Minn M74

3. VARIETY NAME
Royal

4. ADDRESS *(street and no. or R.F.D. no., city, state, and ZIP)*
Univ. of Minnesota, 220 Coffey Hall
1420 Eckles Ave., St. Paul, MN 55108

5. PHONE *(Include area code)*
612-625-7278

FOR OFFICIAL USE ONLY

PVPO NUMBER
9400059

FILING
Date: Jan. 5, 1994
Time: ☐ A.M. ☐ P.M.

FEES RECEIVED
Filing and Examination Fee: $2150 + 175.00
Date: Jan. 5, 1994 & 2/1/94
Certificate Fee: $ 275.00
Date: Aug. 12, 1994

6. GENUS AND SPECIES NAME
Hordeum vulgare L.

7. FAMILY NAME *(Botanical)*
Graminae

8. CROP KIND NAME *(Common Name)*
Barley, six-rowed

9. DATE OF DETERMINATION
November, 1993
~~Feb. 15, 1994~~
AKA 8 July, 1994 per letter

10. IF THE APPLICANT NAMED IS NOT A "PERSON," GIVE FORM OF ORGANIZATION *(Corporation, partnership, association, etc.)*
State, Experiment Station

11. IF INCORPORATED, GIVE STATE OF INCORPORATION
—

12. DATE OF INCORPORATION

13. NAME AND ADDRESS OF APPLICANT REPRESENTATIVE(S), IF ANY, TO SERVE IN THIS APPLICATION AND RECEIVE ALL PAPERS
Donald C. Rasmusson
Department of Agronomy and Plant Genetics
University of Minnesota
St. Paul, MN 55108
PHONE *(Include area code)*: 612-625-7278

14. CHECK APPROPRIATE BOX FOR EACH ATTACHMENT SUBMITTED *(Follow INSTRUCTIONS on reverse)*

a. ☒ Exhibit A, Origin and Breeding History of the Variety.
b. ☒ Exhibit B, Novelty Statement.
c. ☒ Exhibit C, Objective Description of Variety.
d. ☒ Exhibit D, Additional Description of Variety.
e. ☒ Exhibit E, Statement of the Basis of Applicant's Ownership.
f. ☒ Seed Sample (2,500 viable untreated seeds). Date Seed Sample mailed to Plant Variety Protection Office _____
g. ☒ Filing and Examination Fee ($2,150) made payable to "Treasurer of the United States."

15. DOES THE APPLICANT(S) SPECIFY THAT SEED OF THIS VARIETY BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SEED? *(See section 83(a) of the Plant Variety Protection Act.)*
☒ YES *(If "YES," answer items 16 and 17 below)* ☐ NO *(If "NO," skip to item 18 below)*

16. DOES THE APPLICANT(S) SPECIFY THAT THIS VARIETY BE LIMITED AS TO NUMBER OF GENERATIONS?
☒ YES ☐ NO

17. IF "YES" TO ITEM 16, WHICH CLASSES OF PRODUCTION BEYOND BREEDER SEED?
☒ FOUNDATION ☒ REGISTERED ☒ CERTIFIED

18. DID THE APPLICANT(S) PREVIOUSLY FILE FOR PROTECTION OF THE VARIETY IN THE U.S.?
☐ YES *(If "YES," through* ☐ Plant Variety Protection Act ☐ Patent Act. Give date: _____.)
☒ NO

19. HAS THE VARIETY BEEN RELEASED, USED, OFFERED FOR SALE, OR MARKETED IN THE U.S. OR OTHER COUNTRIES?
☒ YES (If "YES," give names of countries and dates) "Released in U.S., February 15, 1994" AKA 8 July 1994 per letter
~~☒ NO~~

20. The applicant(s) declare(s) that a viable sample of basic seeds of this variety will be furnished with the application and will be replenished upon request in accordance with such regulations as may be applicable.

The undersigned applicant(s) is (are) the owner(s) of this sexually reproduced novel plant variety, and believe(s) that the variety is distinct, uniform, and stable as required in section 41, and is entitled to protection under the provisions of section 42 of the Plant Variety Protection Act.

Applicant(s) is (are) informed that false representation herein can jeopardize protection and result in penalties.

SIGNATURE OF APPLICANT *(Owner(s))*	CAPACITY OR TITLE	DATE
Donald C. Rasmusson	Professor	November 17, 1993
SIGNATURE OF APPLICANT *(Owner(s))*	CAPACITY OR TITLE	DATE
Craig Sheaffer Steve R. Simmons (Michael Martin)	Professors Associate Dean	December 10, 1993 December 13, 1993

BARLEY

'Royal'

14A. Exhibit A. Origin and Breeding History of Royal Barley.

'Royal,' a blue-aleurone, six-row spring barley (Hordeum vulgare L.), (Reg. no. cv- _____, PI _____) was developed by the Minnesota Agricultural Experiment Station and released February 15, 1994. Royal is intended for use as a forage-companion crop and grain-feed cultivar. The short-stature of Royal contributes to lodging resistance which enhances its potential as a companion crop and grain-feed cultivar. The name Royal was chosen in part because of its connection with the color royal-blue which is associated with the blue aleurone color of the seed of Royal.

Royal, whose experimental designation was M74, has the pedigree Morex/Bonanza//M32/3/ Robust/4/Azure. The four cultivars in the pedigree have performed well when grown in Minnesota. M32 provided the short-stature trait of Royal. M32 is a Minnesota selection tracing to Minnesota selection M21, which has the short-stature gene, sdw, from Jotun.

The final cross leading to Royal was made in 1989. There was no selection in the F_2 generation and selection for short-stature only in the F_3 generation. Seed from F_3 families was harvested in bulk to permit replicated testing in the F_4 generation. Royal originated from an $F_{2.4}$ line which was selected based on height, lodging resistance and yield in a two-location yield trial in 1991. The $F_{2.5}$ generation was grown as a bulk population in Arizona, winter 1991-92. Head rows tracing to the $F_{2.5}$ line were grown at St. Paul, 1992. Royal is a bulk of ten head rows with similar phenotype. It is uniform in appearance and contains no off-type plants in the reconstituted line. Testing for forage quality, agronomic and disease performance was done in 1992 and 1993.

Seed stocks will be maintained by the Minnesota Agricultural Experiment Station and the Minnesota Crop Improvement Association. Certification will be limited to three generations after breeder seed: Foundation, Registered and Certified. Certified seed will be offered for sale in 1995. Application will be made for protection via the "Certification Option."

9400059

UNIVERSITY OF MINNESOTA

Twin Cities Campus

Department of Agronomy and Plant Genetics
College of Agriculture

411 Borlaug Hall
1991 Buford Circle
St. Paul, MN 55108-6026
612-625-7773
Fax: 612-625-1268

June 1, 1994

Mr. Alan A. Atchley
Plant Variety Examiner
Plant Variety Protection Office
USDA-AMS
NAL Building, Room 500
10301 Baltimore Blvd.
Beltsville, MD 20705-2351

Dear Mr. Atchley:

Subject: PV Application No. 9400059, Barley Variety 'Royal'

Thanks for your letter of May 19, 1994. Below I have provided the information you requested.

Exhibit A (Origin and Breeding History): Stability and uniformity information has been observed over 4 generations.

Correction: Date of Determination: November, 1993

Correction of Item # 19: 'Has the variety been released . . . .?' Change original copy to read "Yes, released in the U.S., February 15, 1994."

Please contact me if you have questions or if additional changes are needed. Thanks.

Sincerely,

Donald Rasmusson

Donald C. Rasmusson
Professor

jds

3

14B. Exhibit B. Novelty Statement.

'Royal' barley (Hordeum vulgare L.) (Reg. No. _____, P.I. _____) is a six-row, smooth-awn, spring barley. Its covered kernels have short hairs on the rachilla and a blue aleurone. The spike is medium-dense, medium-short and semi-erect.

Royal is most similar to Robust and Azure which occur in its pedigree. It can be distinguished from Azure because it has short hairs on the rachilla; Azure has long hairs. This trait, rachilla hair length, is routinely used in classifying barley and in taxonomic keys.

Royal can be distinguished from Robust because it is shorter by several centimeters and because Robust has kernels with white aleurone (as contrasted to blue for Royal). The height difference is large and regularly present. In eleven trials, average height of Royal was 71 centimeters and Robust was 91 centimeters (Table 3). In seven regional trials in 1993, Royal was 73 centimeters and Robust was 92. Currently there are no reported short-stature cultivars like Royal that are grown in Minnesota. Blue aleurone kernel color of Royal is controlled by two complementary genes (Bl and Bl_2) and is a reliable distinguishing character.

Royal also differs from Robust in having greater resistance to lodging which is associated with its reduced height (Table 3). In nine trials, lodging of Robust was 36% and Royal 19%. In five regional trials in 1993, lodging was 44% and 24% for Robust and Royal, respectively.

Table 1. Forage composition and forage yield of Robust and Royal at the soft dough stage of growth. Crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) concentration were measured on whole plants.

Variety	Forage Composition[1] (%)				Forage yield[2] (Mg/ha)
	CP	NDF	ADF	ADL	
Robust	8.8	51.4	31.7	4.0	11.2
Royal	9.2	47.0	28.0	3.2	10.9
LSD 5%	NS	1.8	1.3	0.3	NS

[1] Three locations -- St. Paul, Crookston and Stephen.
[2] Two locations -- St. Paul and Crookston.

Table 2. Grain yield in Mg ha^{-1} of Robust and Royal at five locations in 1992-93.

Variety	Location					Mean
	Crookston	Morris	Stephen	St. Paul	Roseau	
	4[1]	2	1	4	1	12
Robust	5.11	4.14	2.48	4.47	5.00	4.52
Royal	5.60	4.20	3.87	5.43	5.16	5.11
LSD 5%	0.38	0.48	0.38	0.38	0.64	0.22

[1] Number trials.

Table 3. Agronomic traits of Robust and Royal in 1992-93.

Variety	Days to heading	Height (cm)	Lodging (%)	Plump kernels (%)	Net blotch (1-9)[1]
	11[2]	11	9	7	2
Robust	57	91	36	82	4.8
Royal	57	71	19	84	3.1

[1] 1 is best; [2] number trials.

FORM APPROVED: OMB NO. 40-R3822

U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
COMMODITIES SCIENTIFIC SUPPORT DIVISION
BELTSVILLE, MARYLAND 20705

EXHIBIT C
(Barley)

OBJECTIVE DESCRIPTION OF VARIETY

BARLEY (*HORDEUM VULGARE*)

INSTRUCTIONS: See Reverse.

NAME OF APPLICANT(S)

Minnesota Agricultural Experiment Station

ADDRESS (Street and No. or R.F.D. No., City, State, and ZIP Code)

University of Minnesota
St. Paul, MN 55108

FOR OFFICIAL USE ONLY

PVPO NUMBER: 9400059

VARIETY NAME OR TEMPORARY DESIGNATION: M74

Place the appropriate number that describes the varietal character of this variety in the boxes below.
Place a zero in first box (i.e. [0][8][9] or [0][9]) when number is either 99 or less or 9 or less.

1. GROWTH HABIT:

[1] 1 = SPRING 2 = FACULTATIVE WINTER 3 = WINTER [3] Early Growth: 1 = PROSTRATE 2 = SEMIPROSTRATE 3 = ERECT

2. MATURITY (50% Flowering):

[2] 1 = EARLY (California Mariout) 2 = MIDSEASON (Robust ~~Betzes~~) 3 = LATE (Frontier)

[ ] No. of days *Earlier* than . . . . . [ ]
[2] No. of days *Later* than . . . . . [1]
Robust
1 = ~~BETZES~~ 2 = CALIFORNIA MARIOUT 3 = CONQUEST 4 = DICKSON 5 = PIROLINE 6 = PRIMUS 7 = UNITAN

3. PLANT HEIGHT (From soil level to top of head):

[1] 1 = SEMIDWARF 2 = SHORT (California Mariout) 3 = MEDIUM TALL (Betzes) 4 = TALL (Conquest)

[2][0] Cm. *Shorter* than . . . . . [1]
[ ][ ] Cm. *Taller* than . . . . . [ ]
Robust
1 = ~~BETZES~~ 2 = CALIFORNIA MARIOUT 3 = CONQUEST 4 = DICKSON 5 = PIROLINE 6 = PRIMUS 7 = UNITAN

4. STEM:

[1] Exertion (*Flag to spike at maturity*): 1 = 0 - 3 cm. 2 = 3 - 10 cm. 3 = 10 - 15 cm. [1] Anthocyanin: 1 = ABSENT 2 = PRESENT

[ ][5] NO. OF NODES (Originating from node above ground)

[1] Collar Shape: 1 = CLOSED 2 = V-SHAPED 3 = OPEN 4 = MODIFIED CLOSED OR OPEN [1] Shape of Neck: 1 = STRAIGHT 2 = SNAKY 3 = OTHER (Specify) _____

5. LEAF:

[1] Basal leaf sheath (*seedling*): 1 = GLABROUS 2 = PUBESCENT [1] Position of flag leaf (*at boot stage*): 1 = DROOPING 2 = UPRIGHT

[2] Waxiness: 1 = ABSENT (Glossy) 2 = SLIGHTLY WAXY 3 = WAXY [1][8] MM. WIDTH (First leaf below flag leaf)

[1][9] CM. LENGTH (First leaf below flag leaf) [1] Anthocyanin in leaf sheath: 1 = ABSENT 2 = PRESENT

6. HEAD:

[2] Type: 1 = TWO-ROWED 2 = SIX-ROWED [3] Density: 1 = LAX 2 = ERECT (Not dense) 3 = ERECT (Dense)

[2] Shape: 1 = TAPERING 2 = STRAP 3 = CLAVATE 4 = OTHER (Specify) _____ [2] Waxiness: 1 = ABSENT (Glossy) 2 = SLIGHTLY WAXY 3 = WAXY

[3] Lateral Kernels Overlap: 1 = NONE 2 = AT TIP 3 = 1/4 - 1/2 OF HEAD [1] Rachis (*Hair on edge*): 1 = LACKING 2 = FEW 3 = COVERED

7. GLUME:

[2] Length: 1 = 1/3 OF LEMMA 2 = 1/2 OF LEMMA 3 = MORE THAN 1/2 OF LEMMA [2] Hairs: 1 = NONE 2 = SHORT 3 = LONG

[2] Hair covering: 1 = NONE 2 = RESTRICTED TO MIDDLE 3 = CONFINED TO BAND 4 = COMPLETELY COVERED

[3] Awns: 1 = LESS THAN EQUAL TO LENGTH OF GLUMES 2 = EQUAL TO LENGTH OF GLUMES 3 = MORE THAN EQUAL TO LENGTH OF GLUMES

[1] Awn Surface: 1 = SMOOTH 2 = SEMISMOOTH 3 = ROUGH

9400059

8. LEMMA:

[5] Awn: 1 = AWNLESS 2 = AWNLETS ON CENTRAL ROWS, AWNLESS ON LATERAL ROWS 3 = SHORT ON CENTRAL ROWS, AWNLETS ON LATERAL ROWS 4 = SHORT (less than equal to length of spike) 5 = LONG (longer than spike) 6 = HOODED

[2] Awn Surface: 1 = AWNLESS 2 = SMOOTH 3 = SEMISMOOTH 4 = ROUGH

[2] Teeth: 1 = ABSENT 2 = FEW 3 = NUMEROUS

[1] Hair: 1 = ABSENT 2 = PRESENT

[3] Shape of base: 1 = DEPRESSION 2 = SLIGHT CREASE 3 = TRANSVERSE CREASE

[1] Rachilla Hairs: 1 = SHORT 2 = LONG

9. STIGMA:

[2] Hairs: 1 = FEW 2 = MANY

10. SEED:

[2] Type: 1 = NAKED 2 = COVERED

[1] Hairs on Ventral Furrow: 1 = ABSENT 2 = PRESENT

[2] Length: 1 = SHORT (8.0 mm.) 2 = SHORT TO MIDLONG (7.5 - 9.0 mm.) 3 = MIDLONG (8.5 - 9.5 mm.) 4 = MIDLONG TO LONG (9.0 - 10.5 mm.) 5 = LONG (10.0 mm.)

[3] Wrinkling of hull: 1 = NAKED 2 = SLIGHTLY WRINKLED 3 = SEMIWRINKLED 4 = WRINKLED

[2] Aleurone Color: 1 = COLORLESS (White or Yellow) 2 = BLUE

[0][0] PERCENT ABORTIVE

[3][3] GMS. PER 1000 SEEDS

11. DISEASE: (0 = Not Tested, 1 = Susceptible, 2 = Resistant)

[0] SEPTORIA	[0] NET BLOTCH	[2] SPOT BLOTCH	[1] POWDERY MILDEW
[1] LOOSE SMUT	[0] BACTERIAL BLIGHT	[0] COVERED SMUT	[0] FALSE LOOSE SMUT
[2] STEM RUST Susc. to Race QCC	[0] LEAF RUST	[0] SCAB	[0] SCALD
[0] AY	[0] BSMV	[0] BYDV	[ ] OTHER (Specify)

12. INSECT: (0 = Not tested, 1 = Susceptible, 2 = Resistant)

[0] GREEN BUG	[0] ENGLISH GRAIN APHID	[0] CHINCH BUG	[0] ARMYWORM
[0] GRASS HOPPERS	[0] CEREAL LEAF BETTLE	[0] OTHER (Specify) _____	

HESSIAN FLY RACES: [0] GP [0] A [0] B [0] C [0] D [0] E [0] F [0] G

13. CHEMICAL (0 = Not Tested, 1 = Susceptible, 2 = Resistant)

[0] DDT [0] OTHER (Specify) _____

14. INDICATE WHICH VARIETY MOST CLOSELY RESEMBLES THAT SUBMITTED:

CHARACTER	NAME OF VARIETY	CHARACTER	NAME OF VARIETY
Plant tillering	Robust	Seed size	Morex
Leaf size	Robust	Coleoptile elongation	Robust
Leaf color	Robust	Seedling pigmentation	Robust
Leaf carriage	Robust		

REFERENCES: The following publications may be used as a reference aid for the standardization of character descriptions and terms used in this form:

1. Wiebe, G. A., and D. A. Reid, 1961, Classification of Barley Varieties Grown in the United States and Canada in 1958, Technical Bulletin No. 1224, U.S. Dept. of Agriculture.
2. Reid, D. A., and G. A. Wiebe, 1968, Barley: Origin, Botany, Culture, Winter Hardiness, Genetics, Utilization, Pests, Agriculture Handbook No. 338, U.S. Dept. of Agriculture. pp. 61 - 84.
3. Malting Barley Improvement Association, Milwaukee, Wisconsin, 1971, Barley Variety Dictionary.

COLOR: Nickerson's or any recognized color fan may be used to determine color of the described variety.

14D. Exhibit D. Additional Description of Royal.

Royal's forage quality was superior to Robust in evaluations at three locations in 1992 and 1993 (Table 1). Royal had neutral detergent fiber, acid detergent fiber, and acid detergent lignin concentrations of 47.0, 28.0, and 3.2%, respectively, compared to 51.4, 31.7, and 4.0% for conventional height Robust when harvested at soft dough stage of maturity. Based on lower percentages of fiber and lignin, Royal will have increased intake potential and digestibility compared to conventional height Robust. The enhanced intake potential and digestibility of Royal compared to Robust was associated with 27% less stem in the total herbage dry weight. Forage dry matter yield (average of 10.9 Mg ha^{-1} in two trials) and forage crude protein concentration (average of 9.2% in three trials) of Royal were similar to Robust when harvested at soft dough stage.

Lodging resistance and grain yield of Royal were improved compared to Robust (Tables 2 and 3). Lodging resistance of Royal is superior to Robust; in nine trials lodging percentage was 19% compared to 36% for Robust. Grain yield of Royal was 5.1 Mg ha^{-1} in 12 trials compared to 4.5 for Robust. Percentage plump kernels was similar in Royal and Robust (Table 3).

Royal possesses the ND B112 gene for resistance to spot blotch [Bipolaris sorokiniana (Sacc.) Shoemaker]. It has the *Rpg1* (T) gene for resistance to stem rust [Puccinia graminis (Pers.:Pers.) var. tritici] which conditions resistance to current races of stem rust except race QCC. Its reaction to race QCC is moderately susceptible to intermediate. It is susceptible to loose smut [Ustilago tritici (Pers.) Rostr.].

14E. Exhibit E. Statement of the Basis of Applicant's Ownership.

The Minnesota Agricultural Experiment Station is the owner of Royal. The Minnesota Agricultural Experiment Station is the employer of the breeder and agronomists who developed Royal.